# Proposal for an Africa RISING R4D Scaling Partnership

## Title

Improving the Productivity of Barley-Sheep based Production Systems: Scaling out of Improved Barley, Food Legumes and Potato Technologies for Food, Income and Feed Security in the Central and Northern Highlands of Ethiopia

## Background and Justification

Smallholder agriculture is the most important sector of Ethiopia’s economy where more than 80% of the population lives in rural areas, and their main source of income is agriculture (crop and livestock production). The agricultural sector accounts for about 45 percent of the GDP, almost 90 percent of exports, and 85 percent of employm**e**nt. Food, nutrition and feed security nonetheless remain a key challenge to the Government of Ethiopia (GoE). Over the past two decades, the GoE and its development partners have sought to meet this challenge through investments in research for development that directly target a relatively large and chronically food-insecure population and their efforts have brought some changes in terms of increased production and productivity but not enough to feed the increasing human and livestock populations.

The highlands of Ethiopia (> 1500 meter above sea level) account for about 40% of the country’s total area and supports about 80% of the total cattle and human populations. The low crop and livestock productivity of the highlands is mainly due to natural resources degradations (soil erosion, poor soil fertility, acidity, frost, and water-logging); land fragmentation due to high human population density and recurrent drought due to climate change and variability and shortage of feed and poor health for the livestock. Ethiopia is the major barley (food and malt barley) and cool season food legumes (faba bean, field pea and lentil) producing country in sub-Saharan Africa. The importance of potato as food security crop is being realized in the past decades by farmers and is started expanding its production in the highlands of the country to diversify barley, sheep and food legume production system (Table 1).

Table 1. Households, area and productivity of barley, food legumes and potato in three Regional States of Ethiopia, 2014/15 main rainy season

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Region | Crop\* | Households (million) | Area (million ha) | Grain/tuber yield (t/ha) | Straw yield (t/ha)\*\* | PVS Grain/tuber yield AR sites (t/ha) | Estimated straw yield (t/ha) from PVS |
| Amhara | Barley | 1.5 | 0.4 | 1.7 | 2.5 | 3-4 | 4.5-6.0 |
|  | Potato | 0.5 | 0.02 | 15 | - | >30 | - |
|  | Food Legumes | 2.5 | 0.3 | 1.4 | 1.7 | 2-4 | 2.4-4.8 |
| Oromiya | Barley | 1.6 | 0.5 | 2.2 | 3.3 | 3-5 | 4.5-7.5 |
| Potato | 0.4 | 0.04 | 12 | - | >30 | - |
| Food Legumes | 2.2 | 0.2 | 1.4 | 1.7 | 2-4 | 2.4-4.8 |
| Tigray | Barley | 0.4 | 0.09 | 1.7 | 2.5 | >3 | >4.5 |
| Potato | 0.02 | - | - | - | >30 | - |
| Food legumes | 0.3 | 0.02 | 1.3 | 1.6 | 3 | 3.6 |

\*= Food legumes include faba bean, field pea and lentil

\*\*= Grain to straw conversion for cereal = 1.5 and for food legumes= 1.2

In the highlands of Ethiopia sheep rearing is key to the livelihood of small holder farmers in addition to traditional (barley and food legumes) and non-traditional crops like potato are being produced (Table 2). Out of the 29 million sheep in the country, 74% are in Amhara, Oromiya and Tigray regions. The major sources of animal feed in the country are crop residues (32%) and grazing (56%).

Table 2. Importance of barley and sheep in different livelihood zones of Ethiopia

|  |  |  |
| --- | --- | --- |
| Region | Number of livelihood zones | Cereal-sheep livelihood |
| Amhara | 25 | * North Shoa highland sheep and barley * North Shoa wheat, sheep and barley * South Wollo Meher and Belg-Barley and Potato |
| Oromiya | 61 | * Arsi-Bale wheat, barley and potato * Selale Ambo highland barley, wheat and faba bean |
| Tigray | 16 | * Alaje Ofla highland-barley, food legume and potato * Atsbi-Womberta highlands-Barley-sheep |

Barley, cool-season food legumes and potato are produced during the main (*Meher*) and small (*Belg*) rainy seasons in the highlands of Ethiopia. The small rainy season (rainfed and irrigated) covers 4% of the cultivated areas in the country. The production of barley, faba bean, lentil, field pea and potato during the small rainy season helps poor farmers in highlands to bridge the 3-4 months (June-September) food and feed gaps until the main season harvest is available.

Barley is important for food and income generation for poor farmers in the highlands (women and men headed households). It is grown as sole crop and mixed with wheat and faba bean in the highlands where land holding is very low. The brewer by-product (about 76,000 t) from the Beer factories is used as animal feed for urban and Peri-urban livestock producers. Cool season food legumes and potato are also important for food, feed and cash incomes to the small holder farmers.

Barley, food legumes, potato and sheep are important commodities for women headed farmers (18% households are headed by women) contributing mainly to nutrition and food security which are relevant to women, since they are mainly responsible for their children. The legume component improves system productivity through nitrogen fixation; serving as a break for insect pest, weed and disease cycles affecting barley and potato. Food legume straw also enriches nitrogen-rich livestock feed to improve the sustainability of crop-livestock mixed farming systems.

In order to narrow the yield, knowledge and feed gaps, on-farm action research were done for two seasons in four Africa Rising action sites and farmers identified high yielding and disease resistant barley (food and malt), cool-season food legumes (faba bean, field pea and lentil) and potato and associated crop management practices that double productivity of grain and straw yields. The cultivars identified by the participating farmers can be scaled out in bimodal rain fall central and northern highlands where food and feed security is a big issue where small holder farmers are vulnerable from climate variability shocks due to low crop productivity. The crop species, and locations to be used in the scaling out project also fit in the newly developed agricultural commercialization clusters.

Objectives

* To scale out productive barley, cool-season food legumes and potato in central and northern highlands during main and small rainy seasons
* Scale out improved storage techniques to reduce post-harvest losses in food legumes and potato
* Demonstrate/validate integrated crop management options to narrow yield and quality gaps
* Strengthen innovative informal seed system to barley, food legumes and potato cultivars
* Demonstrate/validate effective feeding systems
* Generate new technologies (varieties, agronomic and feeding practices) suitable for producers, consumers and agro-industries
* Study the adoption and impacts of the new technologies on incomes and dietary diversity of farmers
* Strengthen the capacity of farmers, extension staff, seed growers and researchers

## Benefits

The benefits from this scaling out of the project will be:

* Smallholder farmers (male and female) will benefit from increased productivity, reduction of cost of production, increase in incomes and dietary diversification
* Farmers, extension staff and researchers knowledge/skills increased during the implementation of the project
* Incorporation of barley and food legume varieties with food-feed traits to benefit enhanced grain production and straw feed quality.
* Seeds of barley, food legumes and potato will be easily available and seed growers will benefit from seed sales
* Enhanced nutritive value of available feed for sheep
* More sheep in good condition will be available for local markets
* The increased incomes will benefit farmers by improving their quality of life (send their children to school; get better clothing, diet, housing and medical services)
* The project will create good linkages among stakeholders in the project areas to promote new technologies, knowledge/information and skills
* Smallholder farmers can absorb shocks due to drought or any climatic/weather extremes due to asset building

## Research Questions

* What strategies are most effective for improving access to and capacity to use agronomic, feeding options, market and other information by smallholder farmers especially women and youth to achieve sustainable intensification.
* How do smallholder farmers manage the trade-offs between production, sustainability and other socio-economic and environmental factors
* How can the trade-offs between increased production and socio-environmental impacts be analysed and managed across different scales/regions
* What are the key risk factors for smallholders in participating in sustainable agricultural intensification and what risk management strategies can be put in place to manage them
* How can tools and metrics help decision-makers create an enabling environment for smallholder farmers

## Development Partnerships

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| Partners | Contribution | AR support | Comparative Advantage |
| CGIAR | * ICARDA: Barley, food legumes, soil and water and animal feed technologies, seed system, socio-economics * CIP (potato technologies, seed system and post-harvest) * CIMMYT (zero tillage and farm machineries), needs further discussion * ILRI (irrigated fodder production), needs further discussion | *Financial support* | ICARDA:   * Global mandate for barley, durum wheat and small ruminants * Systems approach in research * Long standing successful partnership in Ethiopian Highlands * Most technologies that have been awarded highest AWARDS & PRIZES by the government have a high component of ICARDA contribution.   CIP:   * Global mandate for improving potato |
| Agro Industries | Potential buyers of agricultural product and sellers of animal feed | Technical support | Strategically located |
| EIAR and RARIs | Research backstopping /technology | *Financial support, Capacity building* | Source of technologies , knowledge and information |
| MoAN, MolF BoA | Extension service | Capacity building | Farmer information, extension |
| ATA | Capacity building, Knowledge transfer | Proven technologies and information | Knowledge transfer |
| Universities | Research backstopping /technology | Capacity building | Research, source of technologies |
| NGOs | Capacity building | Proven technology and information | Financial resource, target specific areas |
| Cooperatives and unions/ | Technology multiplication , input supply, output market and credit access | Capacity building | Common interest groups |
| Agro dealers and traders | Input and output marketing | *Capacity building* | Input access |
| Seed enterprises | Seed supply | Technical support | Input access |
| Sheep multiplication centers | Technology multiplication | Financial support/capacity building | Source of improved breeds |

## Impact Pathway

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| --- | --- | --- | --- | --- |
| # | Activities | Outputs | Outcomes | Impacts |
| 1 | * Large scale demonstration of barley (food and malt), food legumes and potato varieties with associated production technologies in the main rainy season * Large scale demonstration of barley (food and malt) barley, food legumes and potato in the small rainy season (rain fed and irrigated) * Demonstration of Innovative post-harvest storage (Hermetic bags, DLS, etc) for potato and food legumes | *Barley, food legumes and potato technologies out scaled in central and northern highlands* |  |  |
| 2 | * Demonstration of integrated management of emerging pests (Parasitic weeds and gall diseases, Aphids) on food legumes * Demonstration of blended fertilizer and weed management practices for barley, food legumes and potato; * Demonstration of *Belg* season potato-malt barley cropping system | *Integrated crop production practices demonstrated* |  |  |
| 3 | * Evaluation of barley and food legumes for fodder production * Evaluation of Irish potato varieties for fodder production * To narrow the capacity gap on fodder establishment and management * Evaluation of barley/food legume straw based feed rations on sheep meat production | *To demonstrate and promote tools and practices for targeting effective sheep feeding options* |  |  |
| 4 | * Evaluations of elite barley, food legumes and potato lines for yield potential from ICARDA and CIP under main and small rainy season * Evaluation of minimum tillage and supplementary irrigation for malt barley and potato in the small rainy season * Evaluation of large seeded faba bean, field pea and chickpea genotypes for green pod production under irrigation * Evaluation of dry raised bed planting for barley and food legumes | *New crop varieties and agronomic practices generated suitable to main and rainy season production* |  |  |
| 5 | * Identify challenge and opportunity of adopting food legume, barley and potato technologies at household level; * Identifying the determinants of the status and intensity of adoption of improved food legume barley and potato technologies; * Quantifying the welfare impact of the decision to adopt and the intensity of adoption of improved food legume barley and potato technologies within and across household | *Analysis of the level and intensity of adoption and impact of improved barley, food legumes and potato technologies analyzed* |  |  |
| 6 | * Organize short-term courses on variety development, integrated crop management, data analysis (crops, livestock and socio-economics), quality analysis and technology transfer * Organize in-country training on seed technology, feed technology, crop improvement, seed marketing and seed business management courses for public, farm machineries; private sector and small- to medium-scale seed producers * Identify and provide critical facilities required for NARS and seed producers | *Capacity of stakeholders strengthened* |  |  |

## Targets / Zone of Influence

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| --- | --- | --- | --- | --- | --- |
| Region | Zone | *Woreda* | No of *Kebele/ Woreda* | Beneficiaries  Per *Kebele/Woreda* | Total No. of Beneficiaries |
| SNNPR | Hadiya | Lemo, Soru and Duna | 12 | 3000 | 18000 |
| Amhara | North Shewa zone | Bassona worena, Tarmaber and Agolelana Terea | 12 | 3000 | 18000 |
| Oromiya | Bale | Sinana, Goba Dinsho | 12 | 3000 | 18000 |
| Tigray | Maichew | Endamoheni, Ofela, Emba –alaje | 12 | 3000 | 18000 |

## Arrangements Required for Monitoring and Evaluation

* Annual review and planning meeting
* Field visit and evaluation
* Reporting

## Communications and Knowledge Management / Transfer

* Farmers field days
* IP meeting
* Flyers, leaflets, posters, manuals , policy briefs
* Seminars, workshops
* Scientific papers, proceedings
* Radio
* Video documentation
* Experience sharing
* Blogs, website reports

Participants in the preparation of the concept note

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